HISTORIC COLUMBIA RIVER HIGHWAY,
MOSIER TWIN TUNNELS
Troutdale vicinity
Multnomah County
Oregon

HAER No. OR-36-T

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
P.O. Box 37127
Washington, D.C. 20013-7127

HAER
ORE
26-TROUT
1T-

HISTORIC AMERICAN ENGINEERING RECORD

INDEX TO PHOTOGRAPHS

HISTORIC COLUMBIA RIVER HIGHWAY, HAER No. OR-36-T
MOSIER TWIN TUNNELS
East of Mosier
Troutdale Vic.
Multnomah County
Oregon

Note: For shelving purposes at the Library of Congress, Troutdale vicinity in Multnomah County was selected as the "official" location for the various structures in the Historic Columbia River Highway documentation.

Roger Keiffer, Oregon Dept. of Transportation Photographer, September 1995.

HAER No. OR-36-T-1 AERIAL VIEW OF WEST PORTAL.

HAER No. OR-36-T-2 AERIAL VIEW OF EAST PORTAL.

James Norman, Photographer, August 1994.

HAER No. OR-36-T-3 GENERAL VIEW OF WEST PORTAL AND APPROACH ROADWAY, LOOKING EAST.

HAER No. OR-36-T-4 APPROACH VIEW OF WEST PORTAL, LOOKING EAST.

HAER No. OR-36-T-5 WEST PORTAL, LOOKING EAST.

HAER No. OR-36-T-6 PERSPECTIVE VIEW OF WEST PORTAL, LOOKING EAST.

HAER No. OR-36-T-7 PERSPECTIVE VIEW OF WEST PORTAL WITH CLIFF FACE, LOOKING EAST.

HAER No. OR-36-T-8 DETAIL VIEW OF WEST PORTAL, LOOKING EAST.

James Norman, Photographer, September 1995.

HAER No. OR-36-T-9 APPROACH VIEW OF WEST PORTAL DURING CLEARING OF TUNNEL, LOOKING EAST.

HAER No. OR-36-T-10 PERSPECTIVE VIEW OF WEST PORTAL WITH CLIFF FACE DURING CLEARING OF TUNNEL, LOOKING EAST.

HAER No. OR-36-T-11 WEST PORTAL DURING CLEARING OF TUNNEL, LOOKING EAST.

HAER No. OR-36-T-12 DETAIL VIEW OF WEST PORTAL AND CLIFF FACE DURING CLEARING OF TUNNEL, LOOKING EAST.

Jet Lowe, HAER Photographer, July 1995.

HAER No. OR-36-T-13 VIEW LOOKING NORTHEAST FROM WEST OF MOSIER TWIN TUNNELS. COLUMBIA RIVER, I84, AND TALUS AT LEFT.

James Norman, Photographer, August 1994.

HAER No. OR-36-T-14 GENERAL VIEW OF EAST PORTAL AND APPROACH ROADWAY, LOOKING WEST.

HAER No. OR-36-T-15 PERSPECTIVE VIEW OF EAST PORTAL, LOOKING WEST.

HAER No. OR-36-T-16 APPROACH VIEW OF EAST PORTAL, LOOKING WEST.

HAER No. OR-36-T-17 EAST PORTAL, LOOKING WEST.

HAER No. OR-36-T-18 DETAIL VIEW OF EAST PORTAL, LOOKING SOUTHWEST.

Jet Lowe, HAER Photographer, July 1995.

HAER No. OR-36-T-19 VIEW OF EAST PORTAL, LOOKING WEST.

HAER
ORE
26-TROUT
1T-

HISTORIC AMERICAN ENGINEERING RECORD

HISTORIC COLUMBIA RIVER HIGHWAY, MOSIER TWIN TUNNELS

HAER No. OR-36-T

Location:	Carrying the Historic Columbia River Highway through headlands between Hood River and Mosier, Wasco County, Oregon; beginning at milepost 72. UTM: 10/623050/5060090 10/623120/5060110 Quad: White Salmon, Wash.--Oreg.
Date of Construction:	1920, 1921, and 1938
Engineer:	Unknown, maybe John Arthur Elliott, locating engineer, or Conde B. McCullough, Oregon State Bridge Engineer
Builder:	A. D. Kern, contractor
Owner:	Oregon Department of Transportation
Present Use:	Closed since 1953; reopened to non-motorized traffic in 1995
Significance:	The only set of highway tunnels with adits or windows in Oregon. One of the few examples of this type of tunnel in the United States.
Historian:	Robert W. Hadlow, Ph.D., September 1995
Transmitted by:	Lisa M. Pfueller, September 1996

PROJECT INFORMATION

This recording project is part of the Historic American Engineering Record (HAER), a long-range program to document historically significant engineering and industrial works in the United States. The HAER program is administered by the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Division of the National Park Service, U.S. Department of the Interior. The Historic Columbia River Highway Recording Project was cosponsored in 1995 by HABS/HAER, under the general direction of Robert J. Kapsch, Ph.D., Chief, and by the Oregon Department of Transportation (ODOT), Bruce Warner, Region One Manager; in cooperation with the US/International Committee on Monuments and Sites (ICOMOS), the American Society of Civil Engineers (ASCE), and the Historic Columbia River Highway Advisory Committee.

Fieldwork, measured drawings, historical reports, and photographs were prepared under the direction of Eric N. DeLony, Chief of HAER; Todd A. Croteau, HAER Architect, and Dean A. Herrin, Ph.D., HAER Historian. The recording team consisted of Elaine G. Pierce (Chattanooga, Tennessee), Architect and Field Supervisor; Vladimir V. Simonenko (ICOMOS/Academy of Fine Arts, Kiev, Ukraine), Architect; Christine Rumi (University of Oregon) and Pete Brooks (Yale University), Architectural Technicians; Helen I. Selph (California State Polytechnic University, Pomona) and Jodi C. Zeller (University of Illinois, Urbana-Champaign), Landscape Architectural Technicians; Robert W. Hadlow, Ph.D. (ASCE/Pullman, Washington), Historian; and Jet Lowe (Washington, DC), HAER Photographer. Jeanette B. Kloos, ODOT Region One Scenic Area Coordinator; and Dwight A. Smith, ODOT Cultural Resources Specialist, served as department liaison.

Additional information about the Historic Columbia River Highway can be found under the following HAER Nos.:

OR-36	HISTORIC COLUMBIA RIVER HIGHWAY
OR-36-A	HISTORIC COLUMBIA RIVER HIGHWAY, SANDY RIVER BRIDGE AT TROUTDALE
OR-36-B	HISTORIC COLUMBIA RIVER HIGHWAY, SANDY RIVER BRIDGE (Stark St. Bridge)
OR-36-C	HISTORIC COLUMBIA RIVER HIGHWAY, CROWN POINT VIADUCT
OR-36-D	HISTORIC COLUMBIA RIVER HIGHWAY, CROWN POINT
OR-24	LATOURELL CREEK BRIDGE
OR-23	SHEPPERDS DELL BRIDGE
OR-36-E	HISTORIC COLUMBIA RIVER HIGHWAY, BRIDAL VEIL FALLS BRIDGE

OR-36-F	HISTORIC COLUMBIA RIVER HIGHWAY, WAHKEENA FALLS FOOTBRIDGE
OR-36-G	HISTORIC COLUMBIA RIVER HIGHWAY, WEST MULTNOMAH FALLS VIADUCT
OR-36-H	HISTORIC COLUMBIA RIVER HIGHWAY, MULTNOMAH CREEK BRIDGE
OR-36-I	HISTORIC COLUMBIA RIVER HIGHWAY, MULTNOMAH FALLS FOOTBRIDGE (Benson Footbridge)
OR-36-J	HISTORIC COLUMBIA RIVER HIGHWAY, EAST MULTNOMAH FALLS VIADUCT (Bridge No. 841)
OR-36-K	HISTORIC COLUMBIA RIVER HIGHWAY, ONEONTA GORGE CREEK BRIDGE
OR-36-L	HISTORIC COLUMBIA RIVER HIGHWAY, ONEONTA TUNNEL
OR-36-M	HISTORIC COLUMBIA RIVER HIGHWAY, HORSETAIL FALLS BRIDGE
OR-49	MOFFETT CREEK BRIDGE
OR-36-N	HISTORIC COLUMBIA RIVER HIGHWAY, TOOTHROCK & EAGLE CREEK VIADUCTS
OR-36-O	HISTORIC COLUMBIA RIVER HIGHWAY, TOOTHROCK TUNNEL
OR-36-P	HISTORIC COLUMBIA RIVER HIGHWAY, EAGLE CREEK BRIDGE
OR-36-Q	HISTORIC COLUMBIA RIVER HIGHWAY, EAGLE CREEK RECREATION AREA (Forest Camp)
OR-36-R	HISTORIC COLUMBIA RIVER HIGHWAY, MITCHELL POINT TUNNEL & VIADUCT (Tunnel of Many Vistas)
OR-36-U	HISTORIC COLUMBIA RIVER HIGHWAY, MOSIER CREEK BRIDGE (Bridge No. 498)
OR-30	DRY CANYON CREEK BRIDGE
OR-27	MILL CREEK BRIDGE
OR-56	COLUMBIA RIVER HIGHWAY BRIDGES

For shelving purposes at the Library of Congress, Troutdale vicinity in Multnomah County was selected as the "official" location for the various structures in the Historic Columbia River Highway documentation project (HAER No. OR-36).

HISTORIC COLUMBIA RIVER HIGHWAY

The Pacific Northwest's Columbia River Highway, later renamed the Historic Columbia River Highway (HCRH), was constructed between 1913 and 1922. It is one of the oldest scenic highways in the United States. Its design and execution were the products of two visionaries: Samuel Hill, lawyer, entrepreneur, and good roads promoter and Samuel C. Lancaster, engineer and landscape architect, with the assistance of several top road and bridge designers. In addition, many citizens provided strong leadership and advocacy for construction of what they saw as "The King of the Roads."

Often, the terms "scenic highways" and "parkways" are used synonymously. Scenic highways are best described as those roads constructed to provide motorists with the opportunity to see up-close the landscape's natural beauty. Parkways are roads or streets often associated with city beautiful campaigns prevalent in the United States in the late 19th and early 20th centuries. They were part of a movement to create park-like settings out of wastelands. Many of the scenic highways in the United States are associated with the country's national park system and were built in the years following the First World War.

Beginning in the 1910s and early 1920s, the National Park Service (NPS) began construction of well-engineered paved roads with permanent concrete and masonry bridges and viaducts to make its park sites more accessible to an increasingly mobile tourist population. These included roads such as "Going-to-the-Sun Highway" in Glacier National Park and "All-Year Highway" in Yosemite National Park. The Historic Columbia River Highway, unlike many of its counterparts, was constructed through county-state cooperation. It became a state-owned trunk route or highway, part of a growing system of routes that criss-crossed Oregon.

Samuel Hill, once an attorney for James J. Hill and his large railroad empire, and later a Pacific Northwest investor and entrepreneur, was the state of Washington's most vocal good roads' spokesman in the late 19th and early 20th centuries. He promoted good roads at Seattle's Alaska-Yukon-Pacific Exposition in 1905, and shortly thereafter helped to establish the department of highway engineering at the University of Washington. With little success in convincing the Washington State Legislature to fund a major highway along the Washington side of the Columbia River, Hill found more receptive ears and pocketbooks with Oregon lawmakers and Portland area businessmen. Construction began on the Historic Columbia River Highway in

1913. By 1922, it was complete, covered in a long-wearing and smooth-riding asphaltic-concrete pavement.[1]

Hill hired Samuel Lancaster, an experienced engineer and landscape architect to design the HCRH. Lancaster was noted for the boulevards that he created around Seattle's Lake Washington in the first decade of the 20th century as a component of the city's Olmsted-designed park system. In 1909 Lancaster became the first professor of highway engineering in Hill's department at the University of Washington. Lancaster accompanied Hill and others to Paris in 1908 for the First International Road Congress, and afterwards the delegation toured western Europe to learn about continental road-building techniques. Seeing roads in the park-like setting of the Rhine River Valley inspired Hill to build a highway along the Columbia River Gorge. By 1912, Lancaster was conducting road-building experiments at Hill's estate, Maryhill, 100 miles east of Portland on the Washington side of the Columbia. The route they subsequently created was not a parkway, in the truest sense, but instead a scenic highway.[2]

The Columbia River Gorge's natural features distinguish it as the ideal setting. This relationship between the natural landscape and the Historic Columbia River Highway was described best by locating engineer John Arthur Elliott. He wrote, "All the natural beauty spots were fixed as control points and the location adjusted to include them." The road passed several waterfalls and rock outcroppings, including Thor's Heights (Crown Point), Latourell Falls, Shepperd's Dell, Bishop's Cap, Multnomah Falls, Oneonta Gorge and Falls, Horsetail Falls, Wahkeena Falls, and Tooth Rock. Natural features were made an integral component of the HCRH.[3]

According to Lancaster, "There is but one Columbia River Gorge [that] God put into this comparatively short space, [with] so many beautiful waterfalls, canyons, cliffs and mountain domes." He believed that "men from all climes will wonder at its wild grandure [*sic*] when once it is made accessable [*sic*] by this great highway." In addition, the promoters sought to create a route that utilized the most advanced techniques available for road construction. In reflecting on the work's progress, Lancaster acknowledged that because of the country's rugged climate, with its wind and rain and winter weather, it had been "slow and tedious and somewhat more expensive than ordinary work." Nevertheless, he and his associates felt they were accomplishing a worthwhile task because, "for if the road is completed according to plans, it will rival if not surpass anything to be found in the civilized world."[4]

In an more practical light, many observers saw the Historic Columbia River Highway as a lifeline connecting Portland with the many commercial and agricultural areas along the Columbia River. Some even envisioned it as part of a spider web of similarly constructed routes radiating out towards central and eastern Washington, and northern Idaho, meeting routes leading to other parts of the region and nation.

The Historic Columbia River Highway was a technical and civic achievement of its time, successfully mixing sensitivity to the magnificent landscape and ambitious engineering. The highway has gained national significance because it represents one of the earliest applications of cliff-face road building as applied to modern highway construction. Lancaster emulated the European styles of road building in the Columbia River Gorge, while also designing and constructing a highway to advanced engineering standards. Throughout the route, engineers held fast to a design protocol that included accepting no grade greater than 5 percent, nor laying out a curve with less than a 200' turning radius. In rare cases where a tighter curve was used, Lancaster reduced grades and widened pavement. The use of reinforced-concrete bridges, combined with masonry guard rails, guard walls, and retaining walls brought together the new with the old--the most advanced highway structures with the tried and tested. In building the HCRH, Lancaster artfully created an engineering achievement sympathetic to the natural landscape.[5]

In the days before the formation of a comprehensive state highway plan, Multnomah, Hood River, and Wasco counties cooperated, sometimes unwillingly, with the newly-formed Oregon State Highway Commission (1913) in constructing the Historic Columbia River Highway. Initially a group of recently elected Multnomah County commissioners, strong supporters of the proposed route, resolved that the highway commission take charge of its road building activities, with access to $75,000 in county tax revenues. Soon crews surveyed the route through Multnomah County and constructed one mile of road.

Boosters stumped for the route's completion to the Hood River County line. Local clubs sent out men and boys for weekend work parties to show public support for the undertaking. One photograph from the period, depicts work parties with picks and shovels in hand and placards such as "Gang No. 7, Portland Ad Club, Stalwarts," or "Gang No. 3, Portland Realty Board, We will ROCK the Earth." The highway received much patronage, although some citizens were less than enthusiastic about its construction. Opponents showed their views with placards declaring, "I WON'T WORK, To Hell With Good Roads, We Don't Own Autos." Many "mossbacks" had no use for good roads and were satisfied

traveling the network of rutted, narrow, steeply-graded backwoods trails. Nevertheless, the public generally supported the highway's construction. Multnomah County Commissioners levied a direct tax sufficient to fund road building to the Hood River County line, and subsequently, the people voted a $1 million bond issue to pave the road with asphalt.[6]

Other counties similarly supported this scenic highway innovation. In 1914, Hood River County voters approved the sale of $75,000 in bonds to initiate their portion of the road's construction. Finally, in 1915, Wasco County commissioners financed a survey to locate the route through their jurisdiction. By 1916, though, the state highway commission was reorganized and given a greater mandate over state highway construction, taking much of it out of local hands. Passage of the Federal Aid Road Acts of 1916 and 1921 gave the Oregon State Highway Commission matching funding to complete the HCRH through Wasco County, and eventually to complete the route to its eastern terminus at Pendleton, in Umatilla County, by the early 1920s. At the same time, the state, working with counties west of Portland, completed another portion of the Columbia River Highway to the sea at Astoria. The entire route became part of the national highway system and was designated part of U.S. 30.[7]

By the late 1930s, construction of Bonneville Dam, a New Deal project aimed at providing flood control on the Columbia River and generating electricity, caused a realignment of a portion of the HCRH near Tooth Rock and Eagle Creek, in eastern Multnomah County. It was evident that the old highway was too outdated to provide safe efficient travel for modern motor traffic. By 1954 it was bypassed in its entirety from Troutdale to The Dalles by a new water-level route. This new road was subsequently upgraded to a four-lane divided roadway and eventually renamed Interstate 84. Only portions of the old route remained as a reminder of its early modern highway engineering accomplishments.

MOSIER TWIN TUNNELS

In 1914 and 1915, the Hood River and Wasco County courts contracted with John Arthur Elliott, a locating engineer, and his crews to prepare a plan and profile of the proposed Historic Columbia River Highway through their counties. Many voters in both counties were reluctant to spend money on constructing the HCRH, including employing a locating engineer to survey a route. Hood River County only approved their bond issue to cover construction on the condition that local businessman Simon Benson would guarantee to make up the difference it costs overran the

bond. Indeed, Benson paid at least $13,000 for costs in Hood River County. Many citizens of Wasco County were equally reluctant to spend their own funds on a new highway. They were satisfied with the present county road system which included grades of up to 18 percent on routes between Hood River and The Dalles.[8]

By late March 1914, John Arthur Elliott reported to Henry L. Bowlby, state highway commissioner, his recommendations for possible road alignments for the HCRH between Hood River and The Dalles. The connection between Hood River and Mosier presented particularly difficult problems. The two alternatives that Elliott put forward included a river route, which followed the general course of the OWRN main line with some variation in elevation to meet certain passes. It was only 5.8 miles long and rose only to an elevation of 160', and used portions of an abandoned railroad grade. He estimated the construction as quite expensive because of the heavy grading necessary to carry the road around many basalt cliffs.[9]

The second alternative was a route that left Hood River and went over the Mosier Hills separating the two towns. Elliott's estimation for constructing a hill route noted equally expensive problems. The existing county road east of Hood River ran on grades of up to 12 percent out of the city to an elevation of nearly 1,600' at the summit, before dropping down into Mosier at grades nearing 18 percent. While he could "develop" road to maintain a grade not to exceed 5 percent out of Hood River by creating a series of loops, he found it difficult to bring the road back down to Mosier because the hillsides sloped toward the river and ended in a high bluff.[10]

Each route had its advantages. The distance between Hood River and Mosier by rail was just over six miles and the proposed river routes for the Historic Columbia River Highway were only slightly longer. The proposed summit route, even at 13 miles, had its advantages also. Elliott believed that in keeping with the practice of advertising the HCRH as a "scenic highway through the Columbia River gorge," its design should partially to the wishes of tourists. "The aim of a scenic highway . . . is to show the country," wrote Elliott. He added, "Not a traveler goes through Hood River without wondering where Mount Hood is and the famous Hood River orchards are. To put a scenic highway down in the river where none of this can be seen would be passing a section made up of views which would leave a lasting impression on the traveler."[11]

The route that Elliott proposed as the best alternative for the HCRH from Hood River to Mosier was a compromise. It rose out

of Hood River on a 5 percent grade, up into the Hood River Valley as far as the "Gravel Pit,"and above the majority of cliffs along the river to a summit of 1,107' before descending on a grade not over 5 percent to Mosier. Nevertheless, Elliott's route was, for the most part, never constructed because it was still too long at 10.7 miles. By late 1916, Elliott left his position with the Oregon State Highway Commission to work as highway engineer for Wasco County. Meanwhile, there was continued skepticism among Wasco County voters about the necessity of any realignment, other than a river route. Some recommended merely adding "heavy" fences to the existing steep county road to "assist poor drivers in negotiating the hill." Others saw the best and most economical route as the one following the river. By October 1917, the Oregon State Highway Commission prepared yet another route plan, this time under the direction of Roy A. Klein, the new locating engineer for the HCRH.[12]

Klein and his associates eventually founded an alignment that followed the river most of the distance. It was farther away from the OWRN main line than the previous river route to avoid closing the tracks because of rock blasting operations. It reached a summit of 522' and the distance between Hood River and Mosier was reduced to 6.3 miles, all the while maintaining a grade of 5 percent or less. The most difficult part of this route, riding high above the water-level OWRN main line on cuts and fills as it hugged the curves of the basalt slopes, was to traverse the leading edge of a basalt bench (a portion of the Bingen Anticline) and run east to a gravel mantle. Evidently, Oregon State Highway Department engineers considered a tunnel the most efficient means to accomplish this difficult task. The firm of A. D. Kern, of Portland, received contracts in 1919 to grade and macadamize the Hood River to Mosier section of the Historic Columbia River Highway and to excavate the Mosier Twin Tunnels.[13]

DESIGN AND DESCRIPTION

The Portland firm of A. D. Kern was awarded a contract on January 7, 1919 to excavate 2.3 miles of the Historic Columbia River Highway and cut the Mosier Twin Tunnels. It brought in men, horses, and wagons, along with a Bucyrus 18B steam shovel, a Marion Standard-Gauge 60 shovel, 30 four-yard ore cars and several Ingersoll-Rand air drills. With thirty men, A. D. Kern could move an average of 1,600 cubic yards of material a day.[14]

The Mosier Twin Tunnels (from west to east) consisted of one 81' bore, 24' of open space, and one 288' bore. Total length was 493', with 369' of that in bores. The ideal finished dimensions were a vertical clearance of 16'-0" with an 8'-8" radius measured from a springline of 7'-4" from the roadbed. Roadway width was

17'-4" Two windows measuring 8' to 10' were bored in the longer, or eastern tunnel to admit light to the shaft and for travelers to glimpse beautiful vistas of the Columbia River Gorge.[15]

No records exist concerning the actual boring operations on the Mosier Twin Tunnels. Nevertheless, documentation on boring the Mitchell Point Tunnel (see HAER No. OR-36-R), some 10 miles west of the Mosier Twin Tunnels illustrates the obstacles encountered by excavators. The tunnels were cut through Columbia River Basalt. The formations encountered at the site between Hood River and Mosier included unstable columnar basalt which had the tendency to cause overbreak when excavators cut the tunnel heading. What John Arthur Elliott, locating and designing engineer, observed when cutting Mitchell Point Tunnel gives insight into the problems A. D. Kern probably encountered cutting the Mosier Twin Tunnels.

The usual process for boring a tunnel was to excavate as far as possible with men and equipment, then cut and remove the heading, and then cut and remove the bench, all the while hoping not to create overbreak, or cutting out more than the dimensions prescribed by the contractor. With bores like the Mosier Twin Tunnels and the Mitchell Point Tunnel, care was taken to prevent a weakening of the outer wall and of taking too much basalt from window openings, or adits. John Arthur Elliott, locating and designing engineer for the Mitchell Point Tunnel observed that the proper combination of firing order, lengths of fuses, and number of sticks of 40 percent DuPont dynamite had much influence on how the heading broke. The wrong combination caused much overbreak and could weaken the outer wall.[16]

Immediately after each shot in the heading, which began about 7' above the roadbed, crews loaded the material into ore cars that were carted off for disposal. Then the roof was trimmed down with hammers and picks to remove all loose material. After this, the bench was removed, and the process started over again until the tunnel was completely bored. Once past the points where adits were intended, crews cut these windows by drilling a hole half way through the wall at the floor of the heading, and then loaded it with just enough explosives to break the hole. Next, workers broke away the loosened rock with picks hammers and small plugs, enlarging the ring until they achieved the desired diameter. This process continued until both tunnel bores were completed.[17]

Care was taken to prevent any debris from rolling onto the OWRN mainline several hundred feet below the tunnel site and throughout the section of alignment extending east and west from the bores. Before blasting, crews constructed rubble walls and

timber barricades along the railroad company tracks, at a cost of nearly $3,800, to prevent chunks of basalt from landing on the right-of-way and delaying trains. Even so they probably only made heavy excavations or blasted with dynamite between train schedules. The contractor also had telegraph company and railroad company communication wires removed from poles and buried along side the tracks, at a cost of over $8,200, to prevent damage to them from falling rock. A dispatcher's box was probably kept near the site to make note of all unscheduled and delayed trains.[18]

As the final phase of construction, a cliff walk was constructed from the area between the two tunnels to the west adit of the east tunnel. It consisted of a walkway with a masonry guardrail, and provided motorists a chance to walk out to the cliff's edge to glimpse spectacular views of the Columbia River Gorge.

By July 12, 1920, A. D. Kern had completed its contract at a cost of $219,339.57. This included $19,938.60 for the actual tunnel construction; $3,395.05 for rubble wall and rail the observation gallery, and a penalty of $790.50 for overbreak (263.5 cubic yards at $3.00). The rest of the contract covered clearing, grubbing and excavation, and supplies and labor for masonry walls and concrete. All costs for constructing this unit of the HCRH, which included the tunnel and 2.3 miles of grading were paid through state funds.[19]

REPAIR AND MAINTENANCE

Boring the Mosier Twin Tunnels was a monumental task for the Oregon State Highway Department and A. D. Kern. In June 1920, even before the contract was completed, a consulting engineer, Lyman Griswold feared that the shorter, or west tunnel was "a serious menace to travel in its present condition." He believed that the state needed to enlarge the bore to permit installation of a wooden lining. Soon, the OSHD's Bridge Department, under the direction of Conde B. McCullough, was preparing plans for lining the west tunnel with concrete and constructing a "monumental" west portal. Meanwhile, by September, Division Engineer H. C. Ingle reported that there was a "big fall of rock" which came out of the west portal of the west tunnel.[20]

At the same time, the Bridge Department was designing a rock catch roof structure for the cliff walk. It was a masonry structure consisting of a windowed wall resting upon the masonry guard rail already in place and a reinforced-concrete roof extending over all of the cliff walk except for the portion laying between the tunnels. The obvious purpose of the rock

catchment was to protect pedestrians from showers of rock from the unstable formations on the hill above. There was no provision in September 1920 plans for a similar structure covering the open roadbed between the tunnels nor the adjacent portion of the cliff walk. Finally, the cliff walk rock catch was never built. Available literature gives no clues concerning discussions among highway department officials regarding this structure. One plan suggests that subsequently the Bridge Department erected barriers and warning signs, along with vertical steel pipes in the adits, in hopes of deterring pedestrians from accessing the cliff walk. However, as late as 1932, after a boy was killed by falling rocks as he stood on the cliffwalk, highway department personnel corresponded about possibly erecting safety barricades.[21]

By late fall of 1920, the Bridge Department abandoned plans for a concrete lining in the west tunnel when continual rock movement "made a rigid lining inadvisable," and focussed instead on lining the bore with 12" x 12" timber sets on 4'-0" centers, with 4" x 6" cedar lagging, and 6" x 6' felloe guards. In addition, cord wood was used to backfill the hollow left by overbreak. The lining created a width curb-to-curb of 17'-6" and a vertical clearance of 16'-0" at the center of the roadway. By April 1921, the department also had completed a project to line about 60' of each end of the east tunnel, with a vertical clearance of only 15'-6".[22]

The Oregon State Highway Department also built masonry portals for both tunnels to stabilize the ends of each bore and create pleasing entrances for motorists. It hired a Mr. C. Camillo of Portland to oversee their construction, with a crew of four stonecutters, three masons, six laborers, and one carpenter. Camillo had previously worked on the Shepperd's Dell portion of the HCRH, completing masonry retaining walls there during the road's original construction. Beginning in the week of December 18, 1920, Camillo's crew commenced quarrying stone and shortly started laying stone for the four portals. They finished during the first week of April 1921, after placing keystone at the top of the east tunnel's east portal and the west tunnel's west portal reading "A. D. 1921." Total cost for lining the tunnels and erecting portal masonry was $20,371.87.[23]

With the advent of larger and more powerful automobiles and freight trucks by the early 1930s, accidents in and around the tunnels increased. Most involved sideswipes with other vehicles or the tunnel portals. The posted speed through near the tunnels was 15 miles per hour. Even as early as 1920, highway department officials expressed concern over speeding motorists and hoped to curtail the problem by placing stop signs at the east portal of

the east tunnel and the west portal of the west tunnel. In 1938, the department considered placing traffic lights at the outside end of the tunnels as a deterrent to speeders. Yet they believed that this posed too great a risk to those who were forced to stop at the west portal of the west tunnel because of repeated raveling of rock. As an alternative, the tunnel portals were widened and the tunnels relined to achieve a width of 20'-0".[24]

In 1938, the highway department dismantled or cut back the portal rings for each of the four portal walls on the Mosier Twin Tunnels and replaced them with cast reinforced-concrete with imitation voissoirs. It also relined both tunnels, removing the often decaying 1921 lining and replacing it with 8" x 12" timber sets spaced solid, or side-by-side, with 2" lagging, and backfilled with cedar cordwood. The department achieved a vertical clearance at the center of the roadway of 17'-2", compared with 16'-0" with the original lining. A realistic vertical clearance for vehicles using two 9'-0" traffic lanes and 1'-0" shoulders, was 11'-6", compared to the unrealistic 7'-0" traffic lanes to achieve a 11'-6" vertical clearance.[25]

The department again considered installing traffic signals in 1942 after reports of vehicles scraping portal rings due to excessive speed or wide loads. It looked at the issue for several years before deciding on how to improve traffic safety at the tunnels. One department maintenance engineer wrote in 1947 that he thought that one-way traffic signals were appropriate but worried about liability if a vehicle were in the path of the almost routine rock falls at the west tunnel's west portal. The motor transport industry actually was a firm promoter of using traffic signals at the tunnels, but the engineer observed that even though the tunnels were signed for 15 miles per hour west bound, which was downhill, "the trucks roar through frequently at 30 to 40 miles an hour." "Trucks have been involved in most of our serious accidents in these tunnels," he added, "and speed has been the contributing factor." Another incident, such as one in 1941, involved a truck and trailer colliding with a tractor-trailer combination, with the second vehicle colliding with the west portal of the east tunnel and losing its load of 30' steel pipe.[26]

After much discussion about the best method for regulating traffic speed and improving safety in the Mosier Twin Tunnels, the highway department decided to install speed control signals and floodlighting instead of one-way signals. This solution was implemented at the request of local residents who regularly traveled this section of the HCRH and worried about becoming victims of rock falls while waiting to enter the west tunnel's west portal.[27]

In May 1949, this safety system included signs stating "Traffic Signals Ahead," and "Tunnel Speed 20 Miles," along with a third sign, "Proceed on flashing Amber--Two Way Traffic," which was connected to an actuator and a red-amber light. Vehicles passing over a trip pad at 20 miles per hour or less caused the signal light to turn from red to a flashing amber, while for those traveling at speeds exceeding 20 miles per hour the lights remained red, requiring drivers to stop. In addition, the department installed 300-watt floodlights at the east and west ends of the tunnel area to give better nighttime illumination. Nevertheless, representatives of the trucking industry continued to protest the highway department's decision to maintain two-way traffic in the tunnels.[28]

By November, the department acquiesced to the trucking industry's demands. After monitoring vehicle volume and speed, it decided to re-signal the tunnels for one-way traffic. Because of concerns about grade and the time it took for trucks to pass through the rock fall area, east bound vehicles received a continuous green light unless a vehicle approached the tunnels from the east. In addition, the point where eastbound traffic was stopped if the signals were actuated was moved to a point 125' west of the west tunnel. Finally, the department installed a wire fence 100' above the west tunnel's west portal to prevent all rocks except large boulders from cascading on to the roadway.[29]

Even with the new signal installation, the highway department continued to investigate the possibilities for enlarging the tunnels to create a 24'-0" roadway and 14'-0" vertical clearances. The estimated cost for doing this in 1950 was nearly $100,000. But before the department could move ahead with these plans, almost continuous raveling of rocks above the west tunnel's west portal caused department engineers to reassess their views about the tunnels' continued use. A talus bank under the cliff high above the west tunnel had started to slide. In March 1953, the local maintenance engineer reported that a sizable section of the rock face had fallen and littered the pavement near the west tunnel's west portal with debris measuring from 6" to 3', with some pieces weighing over one ton. Several automobiles were damaged, and one man was hospitalized. Shortly, the highway department closed the Mosier Twin Tunnels section of the HCRH and diverted traffic on to a nearby section of the nearly completed water-level route, the new alignment for U.S. 30.[30]

The highway department abandoned the Historic Columbia River Highway between Hood River and Mosier, with the end portions

going to Hood River and Wasco counties, and the middle section, including the tunnels, reverting to adjacent landowners. The unused tunnels became a liability for the department. It feared that in their present state they might completely collapse, strewing rubble along the Union Pacific Railroad's mainline (the old OWRN mainline). They also posed a liability for the department concerning trespassers injured by falling rock. So, in 1954, they were backfilled with rubble in an attempt to stabilize them and deter trespassers.[31]

Over the next thirty years the Gorge gradually reclaimed the Mosier Twin Tunnels. Continual rock slides both near the west tunnel's west portal and between the tunnels gradually made them barely distinguishable from the surrounding landscape. Most modern motorists passing along U.S. 30 (later Interstate 80N and then Interstate 84) had no idea that once the main east-west trunk route from Portland passed along this portion of the Columbia River high above on the cliff's edge.

Within the last decade, the Oregon Department of Transportation and private citizens have worked to reclaim abandoned sections of the HCRH for public use. The state plans to reopen Mosier Twin Tunnels and much of the Mosier-to-Hood River portion of the HCRH to pedestrians, bicyclists, and disabled persons.

ENDNOTES

Note: Materials cited as "Thommen Report" were xerox copies of complete files located at the Bridge Section and the Office of General Files, Oregon Department of Transportation, Salem. These include items from the "Microfiched Correspondence Files," the "Bridge Maintenance Files" in the Bridge Section; and "Bridge File 33-12,", "Col. R. H.," and "Tunnels" in the Office of General Files. The document's complete citation is "Historic Structure Report, With Revisions and Supplement to Appendix E, Mosier Twin Tunnels, Br. 00653, Wasco Co, June 6, 1994, [revised] September 27, 1994," by Glen Thommen, P.E., Foundation Engineer, Foundation Unit, Bridge Engineering Section, Oregon Department of Transportation, Salem.

[1]For good syntheses of the Pacific Northwest good roads' movement, see John Kevin Rindell, "From Ruts to Roads: The Politics of Highway Development in Washington State" (M.A. thesis, Washington State University, 1987) and Hugh M. Hoyt, Jr., "The Good Roads Movement in Oregon, 1900-1920" (Ph.D. diss., University of Oregon, 1966); Oral Bullard, *Lancaster's Road: The Historic Columbia River Scenic Highway* (Beaverton, OR: TMS Book Service, 1982): 31; Ronald J. Fahl, "S. C. Lancaster and the Columbia River Highway: Engineer as Conservationist," *Oregon Historical Quarterly* 74, no. 2 (June 1973): 112.

[2]Fahl, "S. C. Lancaster and the Columbia River Highway," 105-07.

[3]John Arthur Elliott, "The Location and Construction of the Mitchell Point Section of the Columbia River Highway" (C.E. thesis, University of Washington, 1929): 3.

[4]Samuel C. Lancaster to Amos S. Benson, 7 February 1914, folder "Multnomah County, 1914," box 4, RG 76A-90, Oregon State Archives, Salem.

[5]Dwight A. Smith, "Columbia River Highway Historic District: Nomination of the Old Columbia River Highway in the Columbia Gorge to the National Register of Historic Places, Multnomah, Hood River, and Wasco Counties, Oregon" (Salem, OR: Oregon Department of Transportation, Highway Division, Technical Services Branch, Environmental Section, 1984): 3.

[6]Ronald J. Fahl, "S. C. Lancaster and the Columbia River Highway: Engineer as Conservationist," *Oregon Historical Quarterly* 74, no. 2 (June 1973): 111; Samuel C. Lancaster, "The Revelation of Famous Highways: A Symposium,"in *American Civic Annual* (n.p., 1929): 109.; see photograph in the Oregon

Historical Society collection, negative no. 38744; C. Lester Horn, "Oregon's Columbia River Highway," *Oregon Historical Quarterly* 66, no. 3 (September 1965): 261.

[7]*Second Annual Report of the Engineer of the Oregon State Highway Commission* (Salem, 1916): 26-30.

[8]*Second Annual Report of the Engineer of the Oregon State Highway Commission* (Salem, 1916): 26-30. See J. A. Elliott [locating engineer] to John H. Lewis, State Engineer, 3 June 1916, and other letters in folder "552, Wasco County, J. A. Elliott, 1916," box 11, RG 76A-90, Oregon State Archives, Salem.

[9]*Third Biennial Report of the State Highway Commission to the Governor, 1917-1918* (Salem, 1919): 111-12; Elliott to Bowlby, 31 March 1914, folder "Hood River County, J. A. Elliott--Resident Engineer, 1914, box 1, RG 76A-90, Oregon State Archives, Salem.

[10]J. A. Elliott to John H. Lewis, State Engineer, 28 March 1916, folder "Report File #21, Survey in Hood River County, 1916," box 9, RG 76A-90, Oregon State Archive, Salem; Elliott, to Bowlby, 31 March 1914, folder "Hood River County, J. A. Elliott--Resident Engineer, 1914, box 1, RG 76A-90, Oregon State Archives, Salem.

[11]Elliott to Lewis, 28 March 1916, folder "Report File #21, Survey in Hood River County, 1916," box 9, RG 76A-90, Oregon State Archive, Salem.

[12]"Description of Work of the State Highway Department In the Counties of the State, 1917-1919," *Third Biennial Report of the State Highway Commission to the Governor, 1917-1918* (Salem, 1919): 111-12; Elliott to Lewis, 28 March 1916, folder "Report File #21, Survey in Hood River County, 1916," box 9, RG 76A-90, Oregon State Archive, Salem; "Mosier Grade To Have Fence; Will Be Widened in Places," *The Dalles Chronicle* (23 August 1916), clipping in folder "553, Wasco County Court, et al., 1916," box 11, RG 76A-90, Oregon State Archives, Salem; John H. Lewis to The Honorable County Court, Wasco County, 24 November 1916, folder "553, Wasco County Court, et al., 1916," box 11, RG 76A-90, Oregon State Archives, Salem; Herbert Nunn, State Highway Engineer, to R[oy]. A. Klein, 6 September 1917.

[13] Herbert Nunn, State Highway Engineer, to R[oy]. A. Klein, 6 September 1917; "Road Board Adopts Hood River--Mosier Survey, Bids Asked, *Portland Oregon Journal* (9 October 1917): 16; "The Mineral Resources of Oregon," (Oregon Bureau of Mines and Geology, 1916): 117; *Fourth Biennial Report of the Oregon State Highway Commission* (Salem [1921]): 128.

[14]"Description of the State Highway Department In the Counties of the State, 1919-1920," *Fourth Biennial Report of the Oregon State Highway Commission* ([Salem 1921]): 388; "Description of the Work of the State Highway Department in the Counties of the State, 1921-1922," *Fifth Biennial Report of the Oregon State Highway Commission* ([Salem, 1922]): 519. See four Weister Company photographs of A. D. Kern's work on the Hood River-to-Mosier section of the HCRH. On the reverse of these images, the numbers and types of equipment used for excavating the HCRH was listed, along with descriptions of work crews, folder "Hood River, Mosier Section of Columbia River Highway," box 2B, PC 2, Manuscripts, Archives, and Special Collections Division, Washington State University Libraries, WSU, Pullman, WA.

[15]See dimensions from Bridge Drawing No. 1639, Bridge No. 653 [tunnel assigned "bridge no."], Drawing Files, Bridge Section, ODOT. See also dimensions and arc and springline as computed by Pete Brooks, architectural technician, Historic Columbia River Highway Recording Project, Historic American Engineering Record, National Park Service, 1995.

[16]John Arthur Elliott, "The Location and Construction of the Mitchell Point Section of the Columbia River Highway, Oregon" (C.E. thesis, University of Washington, 1929): 29-30.

[17]Elliott, "The Location and Construction of the Mitchell Point Section of the Columbia River Highway, Oregon," 30-31.

[18]"Description of the Work of the State Highway Department in the Counties of the State, 1921-1922," *Fifth Biennial Report of the Oregon State Highway Commission* ([Salem, 1922]): 519.

[19]"Description of the Work of the State Highway Department in the Counties of the State, 1921-1922," *Fifth Biennial Report of the Oregon State Highway Commission* ([Salem, 1922]): 519; "Description of the State Highway Department In the Counties of the State, 1919-1920," *Fourth Biennial Report of the Oregon State Highway Commission* ([Salem 1921]): 388. For cost of rubble wall and rail see Herbert Nunn to M. C. George, 21 December 1922, copy in "Thommen Report."

[20]Lyman Griswold to Herbert Nunn, 14 June 1920; and H. C. Ingle to Herbert Nunn, 1 September 1920, copies in "Thommen Report." See also Bridge Drawing No. 1416, Bridge No, 653, Drawing Files, Bridge Section, ODOT, Salem. In its *Fourth Biennial Report*, , pp. 388-89, the Oregon State Highway Department reported that it had advertised for bids for placing a concrete lining in the west tunnel and building a "monumental portal." In addition, a drawing from 1920 shows that the OSHD

also looked into incorporating a castle- or fortress-like tower as part of the new masonry west portal. The tower was never built, and the portal construction was delayed.

[21]See Bridge Drawings Nos. 1415 and 1639, Bridge No. 653, Drawing Files, Bridge Section, ODOT, Salem; W. S. Hodge, Resident Maintenance Engineer, to K. D. Lytle, Division Engineer, Bend, 18 March 1932, copy in "Thommen Report."

[22]*Fourth Biennial Report of the Oregon State Highway Commission* ([Salem, 1922]), 388-89; Bridge Drawing No. 1416, Bridge No. 653, Drawing Files, Bridge Section, ODOT, Salem; "Resident Engineer's Weekly Construction Report," 2 October 1920, 20 November 1920, 27 November 1920, 4 December 1920, 11 December 1920, and 18 December 1920; and C. B. McCullough to R. Archibald, 30 October 1920, copies in "Thommen Report."

[23]R. Archibald to Herbert Nunn, 11 December 1920; Christ Fauerso, Resident Engineer, to C. B. McCullough, 2 January 1921, and "Resident Engineer's Weekly Construction Report," 18 December 1920, 25 December 1920, 8 January 1921, 15 January 1921, 22 January 1921, 29 January 1921, 5 February 1921, 12 February 1921, 12 February 1921, 19 February 1921, 5 March 1921, 12 March 1921, 19 March 1921, 26 March 1921, and 2 April 1921, copies of all in "Thommen Report." The $20,371.87 cost was over $8,000 higher than estimates made in the previous biennium. See *Fifth Biennial Report of the Oregon State Highway Commission*([Salem, 1922]), 510 and *Fourth Biennial Report of the Oregon State Highway Commission* ([Salem, 1921]): 388-89.

[24]R. Archibald to Herbert Nunn, 3 October 1920, and L. V. Koons, District Maintenance Superintendent, to W. E. Chandler, Division Engineer, Bend, 30 March 1942, copies in "Thommen Report."

[25]See Drawing No. 6520, Bridge 2528; and Drawing No. 1416, Bridge No. 653, in Drawing Files, Bridge Section, ODOT, Salem.

[26]W. O. Widdows, Assistant Maintenance Engineer, to E. A. Collier, Maintenance Engineer, 10 September 1947; Koons to Chandler, 30 March 1942; and W. E. Chandler to E. A. Collier, 3 April 1942, copies in "Thommen Report."

[27]F. B. Crandall, Traffic Engineer, to W. C. Williams, 13 May 1949, copy in "Thommen Report."

[28]W. O. Widdows to W. W. Stiffler, 16 May 1949, copy in "Thommen Report."

[29]W. O. Widdows to R. H. Baldock, 25 November 1949, copy in "Thommen Report.

[30]E. A. Collier to R. H. Baldock, 6 March 1953; and R. H. Baldock to Oregon State Highway Commission, 2 December 1954, copies in "Thommen Report."

[31]L. R. Chandler, for E. A. Collier, to R. H. Baldock, 31 July 1953; R. H. Baldock to W. C. Williams, 31 July 1953; W. W. Stiffler to E. A. Collier, 3 August 1953; Dean Swift, for W. E. Chandler, to W. C. Williams, 13 August 1953; and Baldock to Oregon State Highway Commission, 2 December 1954, copies of all in "Thommen Report."

SOURCES CONSULTED

Allen, John Eliot. *The Magnificent Gateway: A Layman's Guide to the Geology of the Columbia River Gorge*. Forest Grove, OR: Timber Press, 1979.

Elliott, John Arthur Elliott. "The Location and Construction of the Mitchell Point Section of the Columbia River Highway, Oregon." C.E. thesis, University of Washington, 1929.

_____. "Report on Columbia Highway, Hood River County, 1914." Copy held by Jeanette Kloos, Oregon Department of Transportation, Region 1, Portland.

Fahl, Ronald J. "S. C. Lancaster and the Columbia River Highway: Engineer as Conservationist." *Oregon Historical Quarterly* 74, no. 2 (June 1973): 101-44

Historic American Engineering Record Inventory Cards: Columbia River Scenic Highway." Prepared by Dwight A. Smith, Highway Division, Oregon Department of Transportation, August 1981.

Horn, C. Lester. "Oregon's Columbia River Highway." *Oregon Historical Quarterly* 66, no. 3 (September 1965): 249-71.

Lancaster, Samuel C. "The Revelation of Famous Highways: A Symposium." In *American Civic Annual* (n.p., 1929): 107-11.

Lockley, Fred. *History of the Columbia River Valley from The Dalles to the Sea*. Chicago: S. J. Clarke Publishing Co., 1928.

Oregon Department of Transportation. Bridge Section. Files

_____. "Historic Structure Report With Revisions and Supplement to Appendix E, Mosier Twin Tunnels, Br. 00653, Wasco Co., September 27, 1994." By Glen Thommen, Foundation Engineer, Bridge Engineering Section, Salem.

Oregon State Archives. RG 76A-90, Oregon State Highway Department, General Correspondence.

Oregon State Highway Department. *Annual* and *Biennial Report*. Salem, 1914-22.

Portland Oregon Journal, 1913-22, 1954

Portland Oregonian, 1913-22, 1954.

Smith, Dwight A. "Columbia River Highway Historic District: Nomination of the Old Columbia River Highway in the Columbia Gorge to the National Register of Historic Places, Multnomah, Hood River, and Wasco Counties, Oregon." Salem: Oregon Department of Transportation, Highway Division, Technical Services Branch, Environmental Section, 1984.

Washington State University Libraries. Manuscripts, Archive, and Special Collections Division, Photograph Collection 2 (PC2).

DATA LIMITATIONS

Research resources documenting the Mosier Twin Tunnels' construction are very limited, but there are very complete files chronicling its renovations, closure, and eventual abandonment.